



NOVOVIEW
SP-X
systems
solutions
in visual
simulation



REDIFFUSION
SIMULATION

A GM Hughes Electronics Company

TECHNOLOGY · EXPERIENCE · COMMITMENT

SINCE THE BEGINNING OF VISUAL SIMULATION, AS A MEANS OF PRESENTING THE OUTSIDE WORLD TO PILOTS UNDER TRAINING ON A FLIGHT SIMULATOR, REDIFFUSION SIMULATION HAS BEEN AT THE FOREFRONT OF THIS DYNAMIC TECHNOLOGY.

► nical needs of our customers and includes the relevant display medium, training databases and complete systems integration with the host simulator.

The headquarters for our visual business is a new purpose built facility one mile from London's



Novoview visual systems are fitted to ► 70% of the world's airline simulators.

Purpose built headquarters of ► Rediffusion's visual business.



Today, through the Novoview SP-X family of systems, Rediffusion offers a complete turnkey solution to the operators of civil and military flight simulators.

Configured around the Evans and Sutherland ESIG* range of image generators, SP-X spans the entire flight training spectrum – from relatively low complexity night/dusk capability, to ultra-high performance systems that support true tactical simulation. As important, every SP-X is matched to the individual training and tech-

▼ In-house SP-X image generator.



Gatwick international airport. It represents a multi-million pound investment that reflects our determination to manage programmes efficiently, to develop new products and to provide the standards of customer support that have seen us dominate the visual simulation business for more than two decades.

Today, that dominance means that some 70% of the installed base of airline flight simulators is equipped with Rediffusion Novoview systems.

It has seen us develop an unprecedented lead in display technology, where our WIDE has revolutionised the realism with which computer generated scenes are presented to pilots on a flight deck.

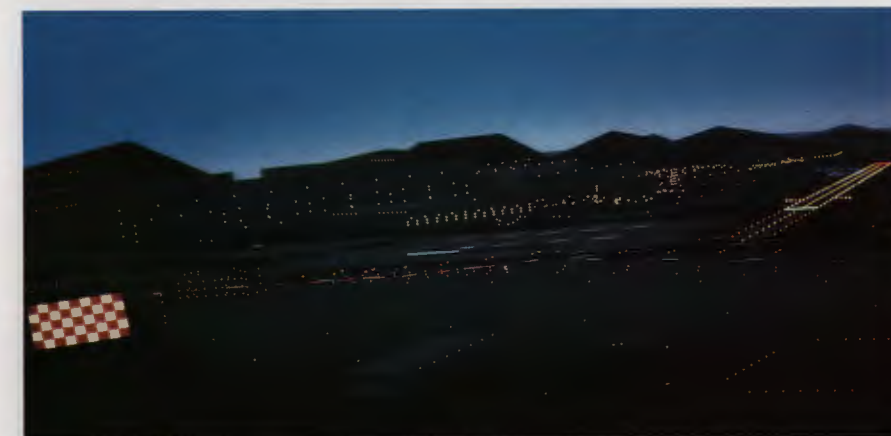
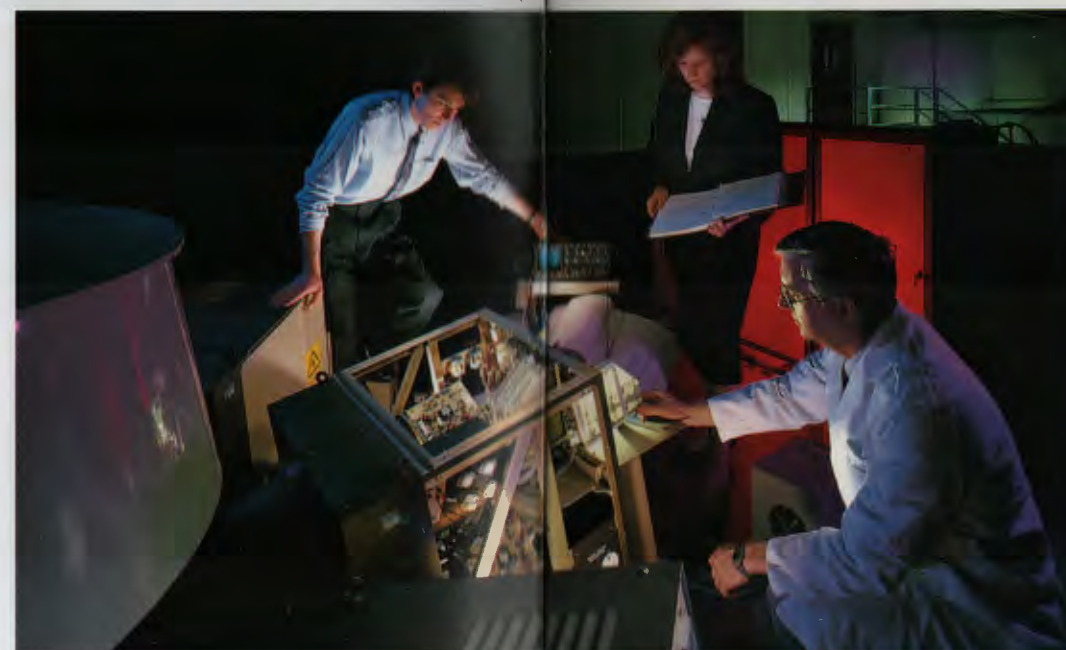
And it is evidence of our total commitment to the performance, reliability and quality of our products.

In both military and civil pilot training, the stakes and, therefore, the risks have never been greater.

As a major flight simulator manufacturer, Rediffusion understands that and, as a result, offers a combination of technology, experience and customer commitment unrivalled in the industry.

* Rediffusion Simulation holds exclusive rights to Evans & Sutherland image generator products in the world civil, and UK military flight simulator markets.

Full training is provided for customer ► maintenance engineers.



► Night SP-X 500 scene – Kai Tak airport Hong Kong.



Spares back up is a major part of customer support.

◄ Rediffusion provides full hardware and software integration with the host simulator.

◄ Modelling and database development facilities.



SINCE ITS LAUNCH, THE NOVOWIEW SP-X FAMILY OF VISUAL SIMULATION SYSTEMS HAS ACCOUNTED FOR 80% OF THE AVAILABLE AIRLINE MARKET WORLDWIDE, AND A SUBSTANTIAL NUMBER OF MILITARY SALES.

SP-X systems have been installed on civil and

► FAA advanced simulation plan.

SP-X 500 incorporates all the features of the 200 product, but extends capability into the full daylight arena. In military aviation, SP-X 500 creates a level of realism that makes true tactical training possible. In civil aviation it meets and

R E A L I S M · R E S O L U T I O N · R E L I A B I L I T Y

military simulators produced not only by Rediffusion, but by all the world's leading simulator manufacturers.

They have been specified by virtually all the major airlines in North America, Europe and the Far East.

And they have consistently achieved the very highest training approvals established by United States Federal Aviation Administration, the British Civil Aviation Authority and many other national regulatory bodies.

There are effectively two SP-X systems relevant to today's flight training environment.

SP-X 200, which creates scenes in night and dusk, but which also has a unique, low visibility daylight capability. The system's advanced specification includes powerful anti-aliasing, texture which can be applied to all polygons in the scene, and the combination of both calligraphic and raster light point generation. In civil aviation, SP-X 200 meets and exceeds the worldwide training equivalents of Phase II of the

exceeds the very highest regulatory requirements established under FAA Phase III and its worldwide equivalents.

Both image generators have been designed to operate with either multiple collimated monitors, or with projector based display systems.

Both are also capable of supporting highly detailed databases which can be developed to meet specific customer training objectives.

And both offer a range of features that equate unequivocally to the best cost/performance relationship in their relevant market sectors. That applies to training value, and to costs of ownership over potentially a 15 to 20 year life-cycle.

With Novoview SP-X, the bottom line is quite simply training efficiency, pilot confidence and proven reliability.

In each it has little competition.

▼ A Novoview SP-X 500HT and SupraWIDE display has been fitted to British Airways' Concorde simulator.



This sequence of pictures demonstrates the impact, and training value, of calligraphic lights. ▲ The left segment shows an SP-X 200 night approach with calligraphic lights. The right segment is the same scene with light points generated in the raster system only. All SP-X image generator and display systems are routinely capable of handling both calligraphic and raster lights.



▲ An extensive library of SP-X civil data bases now exists. They include both real world and generic airports and cover a wide range of training needs.



▲ SP-X 500 takes military simulation into the true tactical training arena.

▲ In all SP-X systems fog is calculated pixel by pixel to create true depth in the image. Notice also how sharp calligraphic lights realistically penetrate the fog.

THE REAL VALUE OF SIMULATION, IN FLIGHT TRAINING, IS TO PROVIDE PILOTS WITH HANDS-ON EXPERIENCE TO THE LIMITS OF OPERATION. IN TERMS OF THE AIRCRAFT, THAT MEANS THE ABILITY TO PRACTICE SYSTEMS' FAILURES AND EMERGENCIES. IN TERMS OF THE VISUAL, IT

► This factor is even more critical in military training where the operational systems of the aircraft – its weapons, avionics and sensors – all have to be integrated with the visual scene. It's here that an investment in SP-X really pays dividends.

P O W E R . P E R F O R M A N C E . P R E C I S I O N



▲ Massive investment has been made in modelling tools to improve efficiency and flexibility of customer response.

► Rediffusion's SupraWIDE projector was designed from the outset for flight simulator application. It is the only such device; in volume production, capable of projecting calligraphic lights.



MEANS THE ABILITY TO REPRESENT AND INTEGRATE ADVERSE WEATHER AND ENVIRONMENTAL EFFECTS.

A leisurely approach into Atlanta on a sunny afternoon is one thing; a difficult approach into Heathrow on a foggy night is quite another. But, unless the runway, the fog and their inter-relationship are all entirely accurate, the pilot very rapidly begins to move into the negative training zone.

▼ Dedicated computing facilities support in-house modelling and development programmes.



It is a fact that the system's technical superiority, and range of features, allows the most cost effective transfer of training across the entire operational spectrum. As a result, pilot acceptance of the system has been universally high; and at British Airways it was considered the only system capable of meeting the airline's own, very demanding, route clearance training into a number of difficult airports.

The key to training success, however, lies as much in the validity of the database as in the power of the machine. Here, Rediffusion has invested heavily in modelling tools that allow us to harness fully the potential of the image generator.

High levels of automation, inherent in these tools, means that customer preferences can be cost effectively met, and that specific training issues can be accommodated within the database.

For the military user in particular, the ability to generate real world terrain patterns, from DMA digital data, is a major advantage, as is the ability to use a wide range of topographical and cultural features from the model library.

Maximising training efficiency and meeting the precise needs of our customers is our first priority in the modelling area.

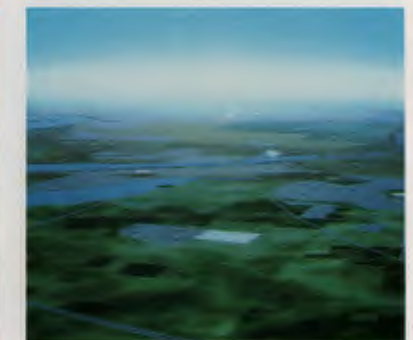
▼ SupraWIDE displays enhance the realism with which computer generated scenes are presented to pilots.



◀ Realistic features, like this cloud formation, can be used to enhance training.



▲ SP-X transparency and animation features can be used to improve scene realism.



▲ A wide range of topographical, terrain and cultural features are available from the model library.



◀ Full demonstration facilities are provided for customers to review modelling progress.

B R I G H T N E S S . I N N O V A T I O N . I N T E G R A T I O N

NOVOVIEW DISPLAY SYSTEMS HAVE BEEN DEVELOPED SPECIFICALLY FOR THE FLIGHT SIMULATION TASK, AND, THEREFORE, FOR THE RIGOURS OF A MOTION ENVIRONMENT. AS A RESULT, THEY ARE INHERENTLY STRONG, RELIABLE AND DEPENDABLE.

► moving the beam on the CRT face to a chosen position, holding it and then unblanking it to create a small spot of the desired intensity. This differs from raster techniques, where lights are created within the actual CRT line structure itself and, therefore, do not allow anything like the

There are basically three display system configurations:

— **monitor systems**, where calligraphic monitors are mounted into collimated display modules located around the flight deck windows. Fields-of-view can be extended by adding modules, and gaps eliminated by juxtaposing the image.

— **SupraWIDE systems**, which use multiple projectors to create a continuous collimated image extending up to 200° horizontally by 40° vertically. Rediffusion was the inventor of this display technology and has developed substantially its performance, capability and reliability. More than 100 WIDE systems have now been sold and those in service have clocked up many thousands of training hours in both civil and military operations.

— **direct front projection**, usually into a dome, or section of a dome, to create extended fields-of-view demanded particularly by many of today's military aircraft.

An important feature of all Rediffusion display systems is that they are all capable of handling calligraphic light point generation. This is especially critical, however, in a projected image and the Rediffusion projector is the only unit in the world, currently in volume production, with this capability.

In calligraphic systems, lights are created by

range of brightness, or precision in terms of size and position.

As a result, calligraphy produces pin-sharp light points so that runway definition, at night or in fog, is realistically represented. This is especially important — in fact essential — in simulating landing aids like VASIs or PAPIs or, in the military, FLOs for carrier approaches.

All this, together with fully digital set up facilities, puts Novoview display technology quite simply light years ahead of its competition.

Since its launch in 1981, the WIDE display system has been continuously developed and improved. ▼

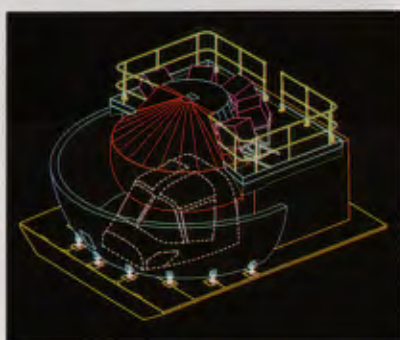


The first five projector WIDE II display is in service on the Royal Navy's Sea King helicopter simulator. ▼



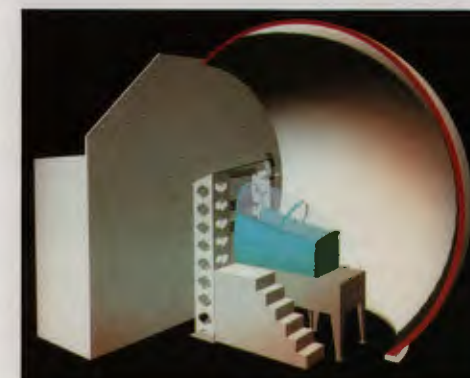
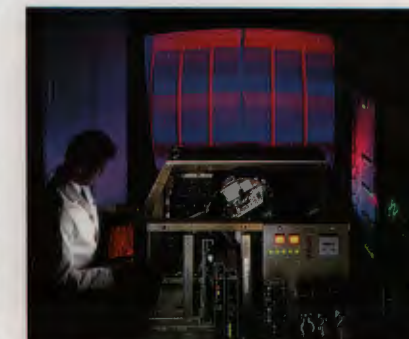
A digital remote control unit aids setup and calibration of SupraWIDE display systems. ▲

SupraWIDE creates continuous fields of view ► extending upto 200° horizontally by 40° vertically.



◀ Rediffusion projectors are also used in dome displays like this unit for the Swiss Air Force Hawk programme.

▼ Rigorous projector testing takes place prior to simulator integration.



▲ Through a majority interest in Projectron Inc, Rediffusion controls the supply, quality and development of its projector tube assemblies.

◀ Rediffusion Novoview visual systems have been fitted to simulators produced by all the world's major manufacturers.



AS TECHNOLOGY HAS EXTENDED THE CAPABILITY OF CGI VISUAL SYSTEMS, SO THE CRITERIA BY WHICH THEY ARE JUDGED HAS BECOME INCREASINGLY COMPLEX.

At the same time, issues of engineering practicality often have to be considered and balanced

- ▶ In defining the basic parameters of your visual system, do the regulatory requirements fully encompass your training needs?

Very often they do not.

SYSTEMS EVALUATION

against realism, cost and training value. At Rediffusion we have designed Novoview SP-X to balance all those parameters and to provide the most cost effective training solution over an extended 15 to 20 year product lifecycle.

We believe this raises issues of how visual systems are evaluated against each other, and to the understanding of the true points of comparison. We have, therefore, outlined below what we believe are the essential questions any operator should ask in evaluating an advanced computer generated image system.

- ▶ Is the image generator performance matched precisely to your training needs?

Counting polygons and light points is no longer an adequate benchmark. All commercial, and most military, visual training demands high fidelity (calligraphic) light point simulation, and precise 3D fogging. Users requiring daylight are advised to evaluate realism on an operational model. Demonstration models can easily be enhanced and, therefore, can be very misleading.

- ▶ Is the display system matched to your needs?

WIDE type displays are now available from several manufacturers, although most have little operational experience. Make sure you operationally evaluate all systems in an integrated simulator environment. Don't assume that simply because one system works others will too, or that what can be achieved in a development lab will operate reliably 20 hours a day, 7 days a week.

- ▶ Is the total system integrated and well proven?

Again, beware of an attractive paper specification or a laboratory demonstration. Translating either into reliable, operational service can prove to be very difficult and always takes longer than expected. In any event both options involve massive risk.

- ▶ What is the true cost of ownership?

Be sure to get field proven data, not estimates which very often are made by optimists.

- ▶ Can the selected systems be maintained within the training environment?

Issues here are:

- ☐ Daily set up time.
- ☐ Tube assembly change time and realignment.
- ☐ Mirror change time.

- ▶ Does your selected visual system supplier have a good record of development investment in visual products?

The life of a simulator could well be over 15 years and protection of your investment is important. Lack of development investment may mean your supplier isn't in business when you need him in later years.

CUSTOMER LIST

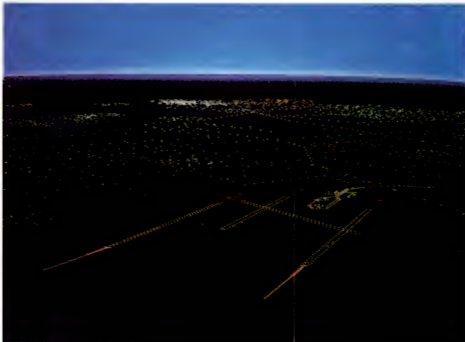
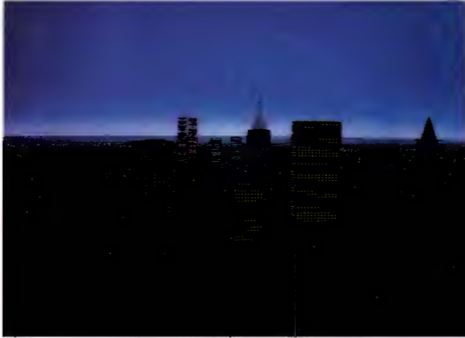
NOVOVIEW SP-X

Aer Lingus
Air Canada
Air France
Air India
Alaska Airlines
All Nippon Airways
American West Airlines
British Aerospace
British Airways
British Caledonian Flight Training
Cathay Pacific
China Airlines
Delta Airlines
Japan Air Lines
KLM - Royal Dutch Airlines
Korean Air
Kuwait Airways
Lufthansa
Monarch Airlines
Northwest Airlines
Royal Air Force
Royal Jordanian
Singapore Airlines
Swiss Air Force
TAP Air Portugal
United Airlines
United States Navy

WIDE

Aer Lingus
Air Canada
Air France
Air India
Air New Zealand
Alitalia
All Nippon Airways
Ansett Airlines
Boeing Commercial Airplane Co.
Boeing Military
Britannia Airways
British Airways
British Aerospace
British Caledonian Flight Training
British International Helicopters
Cathay Pacific
China Airlines
Delta Airlines
Federal Express
Flight Safety International
Helikopter Service
Indian Airlines
Japan Air Lines
Korean Air
Kuwait Airways
Lufthansa
Monarch Airlines
Northwest Airlines
Northrop
Orion Airways
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Royal Jordanian
Royal Navy
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Singapore Airlines
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TAP Air Portugal
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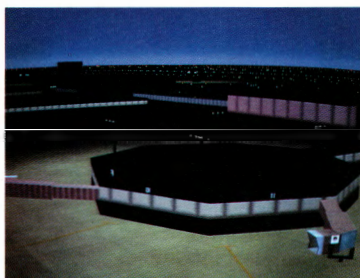
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- Powerful anti-aliasing to ensure high picture quality.
- Advanced texture can be applied to all polygons in the scene and may be translated in real-time for dynamic effects.
- Fog is calculated at the pixel level for correct results on three dimensional objects.
- Self-luminous polygons for enhanced scene realism.
- Superior quality calligraphic light capability coupled with high quality raster image of surfaces. Raster lights are also available for special applications such as cultural lighting and wet runway light reflections.
- Powerful schemes for inclusion of 6 degree of freedom moving objects and dynamic special effects in the scene.
- Comprehensive scene management techniques to ensure constant high density images.
- Highly sophisticated overload management provides a graceful and non-distracting solution to temporary overloads whilst maintaining image quality and integrity.
- Fast and efficient board level diagnostics to facilitate equipment trouble shooting, maintenance and repair.
- Compatibility with a range of visual displays.



S P - X 2 0 0 F E A T U R E S



SYSTEM CAPACITY

Displayed surfaces per channel	225
Displayed surfaces – 3 channels	675
Displayed lights (simultaneously with surfaces) per channel	4800
Displayed lights (simultaneously with surfaces) – 3 channels	14400
Update/refresh rate:	30 Hz
Resolution	400,000 pixels per channel

Maximum no. channels

8

SURFACE FEATURES

No. of grey shades	256
No. of colours (optional)	256
Texture types:	
intensity modulation	Yes
colour blending	Yes
transparency modulation	Yes
Texture on any surface	Yes
Self luminous surfaces	Yes
Directional illumination	Yes
Anti-aliasing	Yes

LIGHT POINT FEATURES

Calligraphic lights	Yes
Raster lights	Yes
Number of colours	> 16
Random light intensity	Yes
Number of light strings	No practical limit
Light string types:	
straight	Yes
curved	Yes
random	Yes

ENVIRONMENTAL EFFECTS

Pixel fog	Yes
Thunderstorm cell	Yes
Wet runway	Yes
Snow covered runway	Yes
Ice covered runway	Yes

OTHER FEATURES

Levels of occultation	No limit
Number of landing lights	7
Number of simultaneous dynamic coordinate systems	3 to 13
Animation capability	Yes
Level of detail management	Yes
Database storage	Hard disk
Backup media	Tape streamer/ flexible disk
Cabinets for 4 channels	1
Optional low visibility daylight capability	Yes

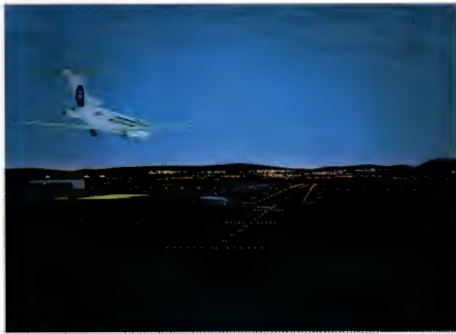


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- Transparent and self-luminous polygons for enhanced scene realism.
- Superior quality calligraphic light capability coupled with high quality raster image of surfaces. Raster lights are also available for special applications such as cultural lighting and wet runway light reflections.
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- Compatibility with a range of visual displays.



 **REDIFFUSION
SIMULATION**

A GM Hughes Electronics Company

S P - X 5 0 0 F E A T U R E S



SYSTEM CAPACITY

Displayed surfaces per channel	500
Displayed surfaces – 3 channels	1500
Displayed lights (simultaneously with surfaces) per channel	1000 (day) 5000 (dusk/night)
Displayed lights (simultaneously with surfaces) – 3 channels	3000 (day) 15000 (dusk/night)
Update/refresh rate:	
Day	50 Hz
Dusk/night	30 Hz
Standard resolution	360,000 pixels per channel
High resolution	720,000 pixels per channel
Maximum no. channels	8

SURFACE FEATURES

Number of colours	256
Texture types:	
intensity modulation	Yes
colour blending	Yes
transparency modulation	Yes
Texture on any surface	Yes
Transparent surfaces	Yes
Self luminous surfaces	Yes
Directional illumination	Yes
Anti-aliasing	Yes

LIGHT POINT FEATURES

Calligraphic lights	Yes
Raster lights	Yes
Number of colours	> 16
Random light intensity	Yes
Number of light strings	No practical limit
Light string types:	
straight	Yes
curved	Yes
random	Yes

ENVIRONMENTAL EFFECTS

Pixel fog	Yes
Thunderstorm cell	Yes
Wet runway	Yes
Snow covered runway	Yes
Ice covered runway	Yes

OTHER FEATURES

Levels of occultation	No limit
Number of landing lights	7
Number of simultaneous dynamic coordinate systems	3 to 13
Animation capability	Yes
Level of detail management	Yes
Collision detection	Yes
Height above terrain	Yes
Weather radar correlation	Yes
Database storage	Hard disk
Backup media	Tape streamer
Cabinets for 3 channels	2



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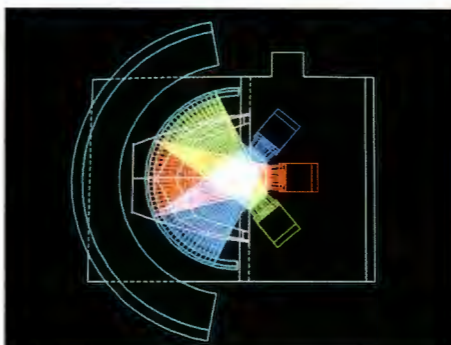
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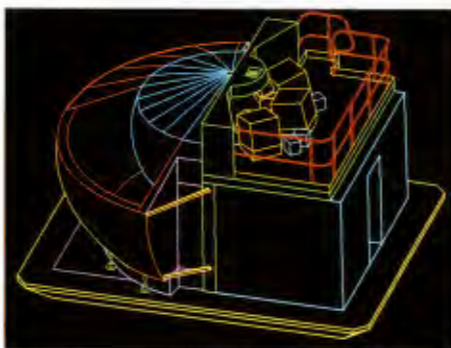
SP-X MONITOR DISPLAYS

- Available with full colour and, for dusk/night systems, beam penetration monitors
- Beam splitter and mirror combination provide collimated display
- Choice of field-of-view available as a result of stacking or juxtaposing of displays
- Compact system with low mass and inertia
- High quality glass optics, hard coated for easy maintenance
- High quality displayed scenes – high brightness and contrast
- Minimal geometric distortion inherent in on-axis system
- Remote control unit for maintenance adjustments

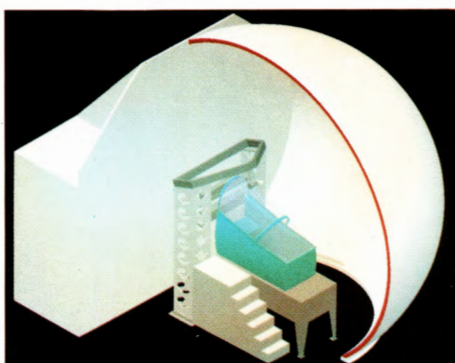


SP-X PROJECTED DISPLAYS: SupraWIDE

- Continuous uninterrupted field-of-view of 150° and 200° horizontally by 40° vertically
- Continuous collimated full colour display viewable from anywhere within the cockpit
- Inherent immunity to spurious reflections permits use of high cockpit ambient light levels under days conditions
- SupraWIDE uses advanced projection tubes producing minimal variation of brightness and resolution across the field of view
- SPHERE (Spherical Reference Equipment) and DRCU (Digital Remote Control Unit) permit rapid and consistent maintenance
- Signal input allows compatibility with calligraphic, raster scan or hybrid image generators
- Simplicity of design ensures high reliability, minimal maintenance and low cost of ownership. For an average training schedule the operating cost of a SupraWIDE I display system is typically \$30,000 per annum
- Meets all current international regulatory requirements up to FAA Phase III and equivalent



S P - X D I S P L A Y S



SP-X PROJECTED DISPLAYS: SupraWIDE

Field-of-view:

150° horizontally by 40° vertically from 3 channels, biased vertically
 +25°, -15°
 +20°, -20°
 +15°, -25°

200° horizontally by 40° vertically from 5 channels, biased vertically
 +20°, -20°
 +15°, -25°

(5 projector display allows optional use with 4 channel switchable image generator)

SP-X PROJECTED DISPLAYS: DOMES

- Continuous uninterrupted field-of-view of 200° horizontal by 60° vertically with 5 channels
- Full colour real image display suitable for single or tandem seat configuration
- Minimum geometric distortion for design eye point
- Inherent immunity to spurious reflections permits use of high cockpit ambient light levels under day conditions
- Advanced projection tubes produce minimal variation of resolution across the field-of-view
- Sphere (spherical reference equipment) and (digital remote control unit) permits rapid and consistent maintenance
- Signal input allows compatibility with calligraphic raster scan of hybrid image generators
- Simplicity of design ensures high reliability, minimal maintenance and low cost of ownership



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